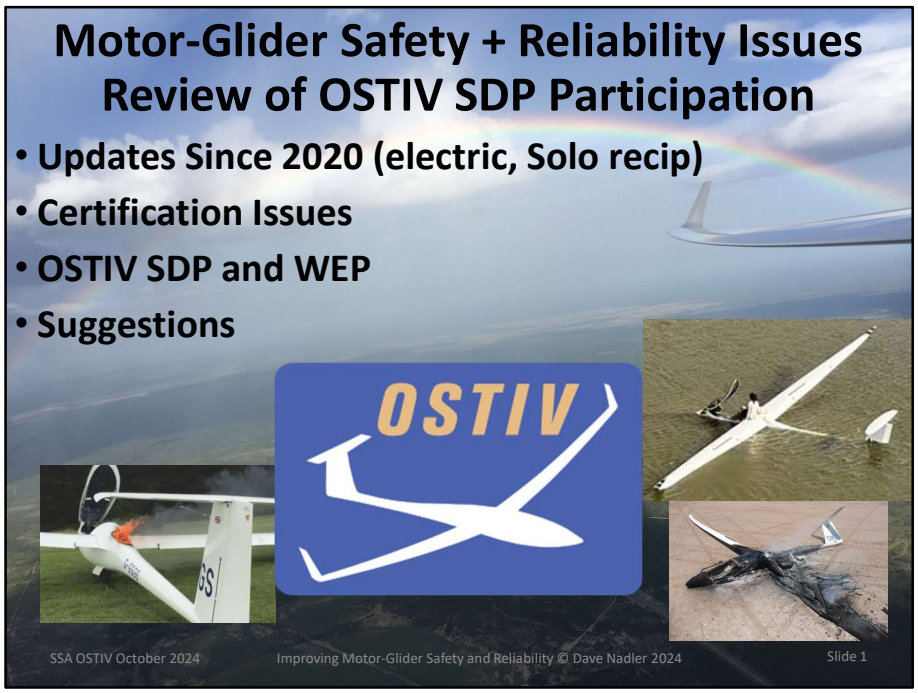


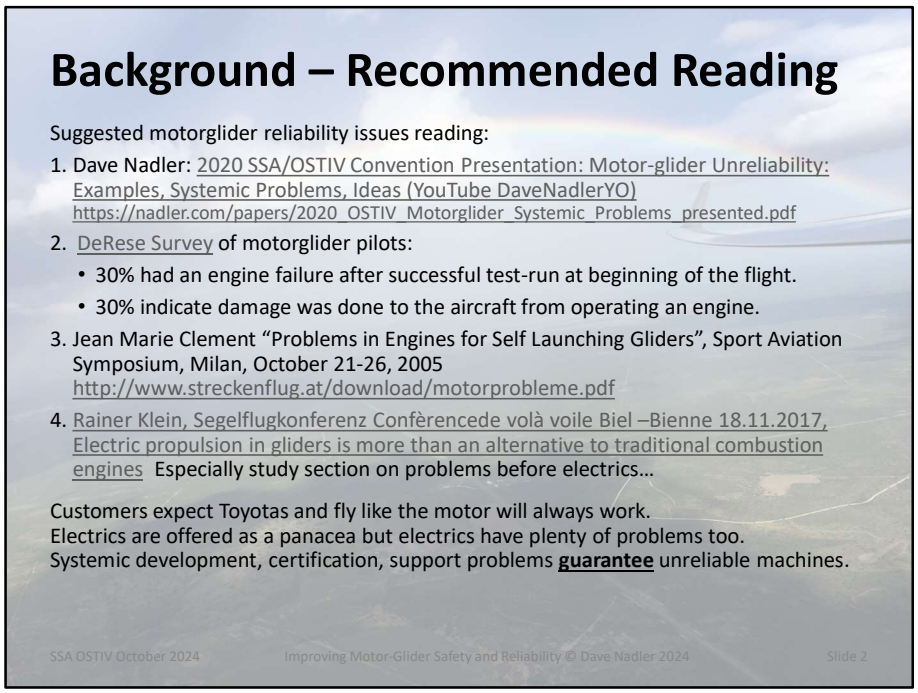
Dave's background:
Almost 5000 hours gliding, half in motor-gliders, and almost 300,000km XC
Electrical Engineering degree from MIT, commercial engineering since 1973
5 decades(!) experience:
- developing and managing development of products (systems, software, electronics, embedded)
- repairing projects and organizations having difficulty delivering
Focus on delivering quality products, on time and on budget.

In gliding, many of you know me as:
- the principal designer/developer of ILEC SN10 flight computer/vario,
- one of the PowerFLARM developers.
- 2020 SSA/OSTIV Convention presentation "Motor-glider Unreliability: Examples, Systemic Problems, Ideas":
  https://www.youtube.com/watch?v=R--m0NDR0j8
- OSTIV/SSA presentation "In Search of the Perfect Vario":
  https://www.youtube.com/watch?v=YpA_9nSjFdA
- one of your glider customers ;-)

Absolutely NOT expert on certification rules or glider manufacture!

Motorgliders work well enough to be popular! I recently bought my 4th.
All motorgliders have significant room for improvement.

Difficulties with assorted motorgliders led to my 2020 presentation,
which in turn led to my invitation to join OSTIV SDP.
Today's discussion will discuss what is, and especially what is NOT happening…



Reliability problems become safety problems when pilots assume motor will work.

If you haven't seen my 2020 presentation, please watch it on my YouTube channel https://www.youtube.com/user/DaveNadlerYO

Motorgliders are created by tiny companies with limited resources.
We're not here to throw stones, but to see how reliability and safety can be improved given these limitations.

Updates Since 2020

- Jet sustainer reliability – no good stats. Retrofit from M&D for ASW-27/29 soon.
- Electric propulsion new models, issues
  Photo courtesy Mark Keene

- Recent progress on Solo vibration

SSA OSTIV October 2024 Improving Motor-Glider Safety and Reliability © Dave Nadler 2024 Slide 3

Jet sustainers were not covered in 2020 presentation – I don't have good statistics.
Big advantage out but not running: very low drag (lower drag than electric failures).
Issues include reliability and density altitude.
Continued enhancements to improve reliability and density-altitude tolerance…

Several new electric-powered gliders shipping (one amphibious).
Ventus 2E and AS-33me were reported to me as only ones without issues at Uvalde.

Mis-Adventure with a New Electric

As recounted by a friend in 2023…

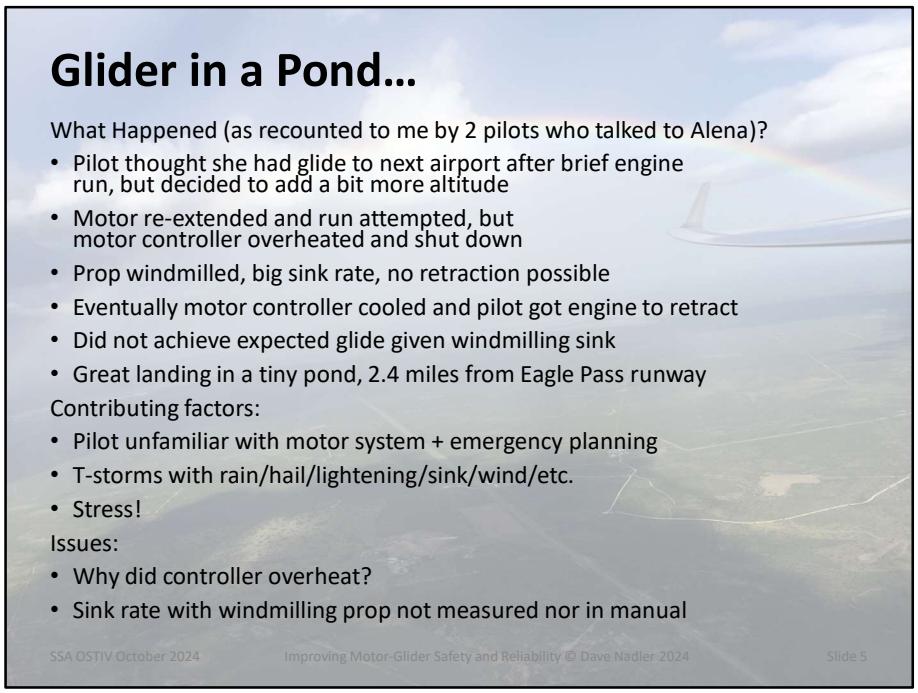
- Original PCBs (circuit boards) had no means of field software update, and required replacement.
- On take-off (Uvalde Texas, 42C ***hot, over book limits***): ***Controller powered back*** at low altitude (controller overheated). Pilot had not planned for an abort, and continued launch into extremely dangerous low-altitude circuit. Dangerous to power back…
- Warning hides important info.
  Also happens with recip Solo/ILEC.
- Should we require operation at 45C? More?

This is not first-hand - this is as recounted by the pilot/customer/friend.

Insufficiently-tested/debugged stuff still gets to a customer?

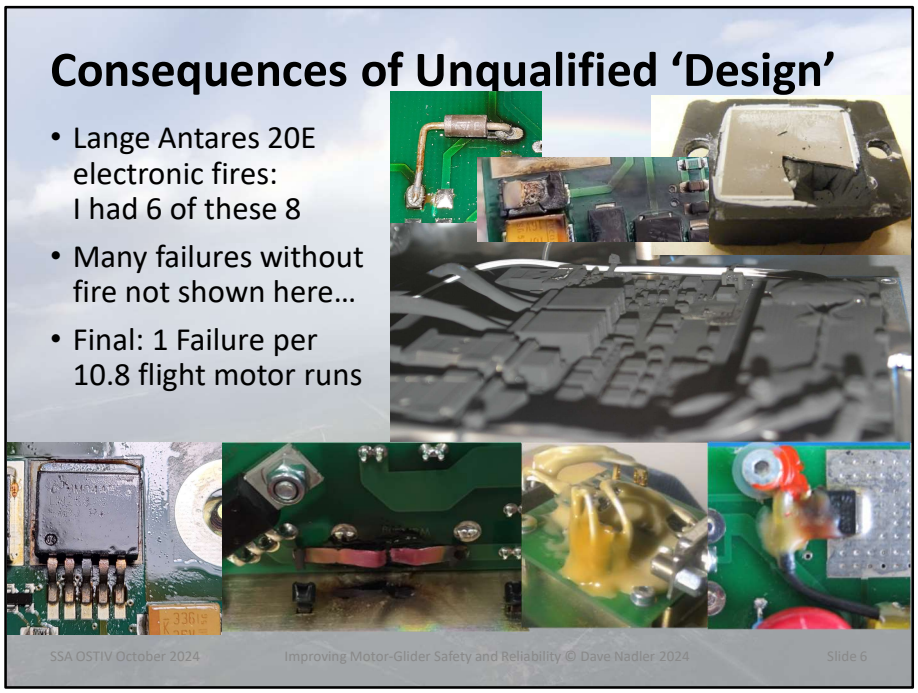
Next bit indicates a training problem, at least with this pilot!
Take-off was attempted at about 42C, beyond allowable limits.
Pilot freely admits extremely bad decisions:
- attempting take-off beyond temperature limits
- not to land straight ahead at first indication of problem

Manufacturer confirms they installed controller without proper cooling.
Rough numbers to illustrate the scale:
5% inefficiency for 40 kW -> means 2kW cooling – Two big hair driers!
Design updated to add cooling....



Planning must always be around worse-case sink rate:
Motor out and not running (maybe doors open, maybe windmilling)

Never, ever, ever mess with motor before setting up for a landing.



Previously I showed you 4 fires I had out of 5 fire design mistakes I knew about.
Updated in 2023 with:
- 2 more burned components found by the guy who bought my Antares!
- another failure someone else sent to me.

One failure like this is bad, two serious, three extremely concerning…
Eight? Un-Fucking Believable.
Clearly shows unqualified engineers and no safe review process.

Lots of detail was provided to EASA:
how, why, who, when, where, engineering explanation, etc.
What has EASA done?
Once again:
- It is EASA policy not to provide feedback
- If no feedback is provided, perception is EASA does nothing.
- If EASA is perceived to do nothing, no-one will make submissions
- EASA is concerned it does not receive submissions
What is wrong with this picture?
Hello?

Lots of great engineering overwhelmed by the bad stuff.
A chain is only as strong as the weakest link;
reliability only as good as the worst part…

Big fires start with… small fires.
Discolored epoxy shows severe component overheating.

Lange is an extreme case, but illustrates what we especially need to prevent.
Continuing financial problems preclude hiring qualified staff or 3rd party.
Same unqualified individual likely caused at least 5 of the above problems;
he has no electronics training and no reviews by a qualified engineer.

At least four of these were caused by changes to original design by unqualified individuals.

Electronic design is not trivial.
Electronic design for aircraft should only be performed by qualified engineers.

Initial type certificate, maintenance of type certificate and maintenance of organization's production certificate must not allow this kind of behavior.

Lange propulsion system failures I experienced: ~1/2 failures due to serious engineering errors.
10.8 runs/failure is 25 failures in 271 motor runs (168 launch, 103 air-start, not including taxi or test runs).

Solo Vibration Progress…

- As covered in my 2020 presentation, reciprocating engines (Solo) have severe vibration problems. Motor-glider Unreliability: Examples, Systemic Problems, Ideas
- Project of Ontrack Technologies with Solo
- Video, not to be reproduced or circulated… Jonkers_VIDEO-2024-09-
- Work ongoing (prototype -> product)
- Hopefully soon available as retrofit!

SSA OSTIV October 2024 Improving Motor-Glider Safety and Reliability © Dave Nadler 2024 Slide 7

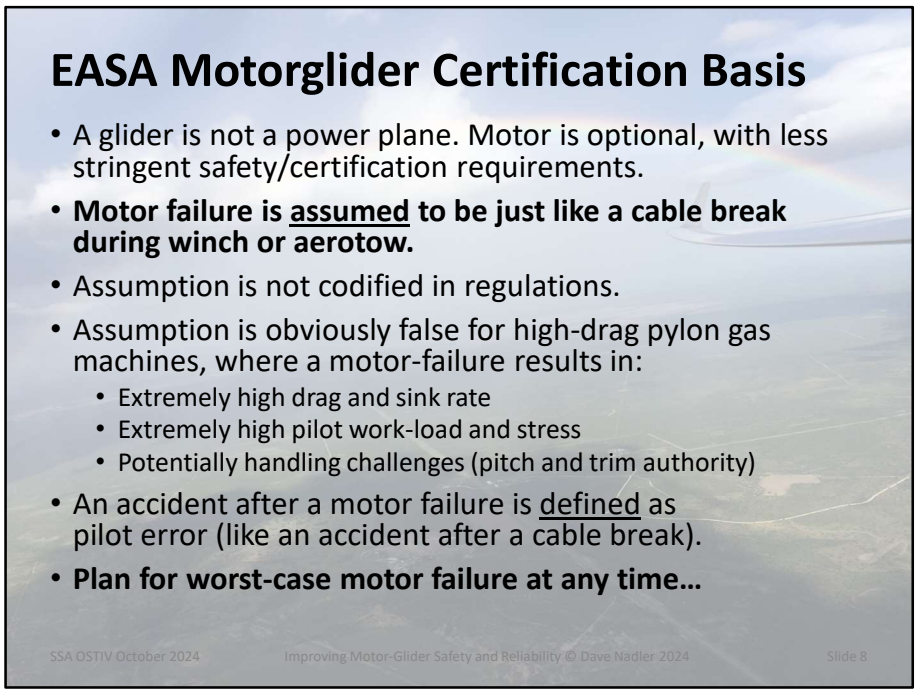
Most of you saw my 2020 presentation:
2020 presentation here: https://www.youtube.com/watch?v=R--m0NDR0j8
I discussed Solo vibration issues (due to no balance shaft), and suggested an OSTIV project to analyze using high-speed photography, and then improve the situation…
People told me I was exaggerating, then they saw the video…

Good video explaining how balance shafts work (applicable to 2 cylinder 2 stroke):
https://www.youtube.com/watch?v=hwigSbyQ7AI

https://ontracktechnologies.co.za/

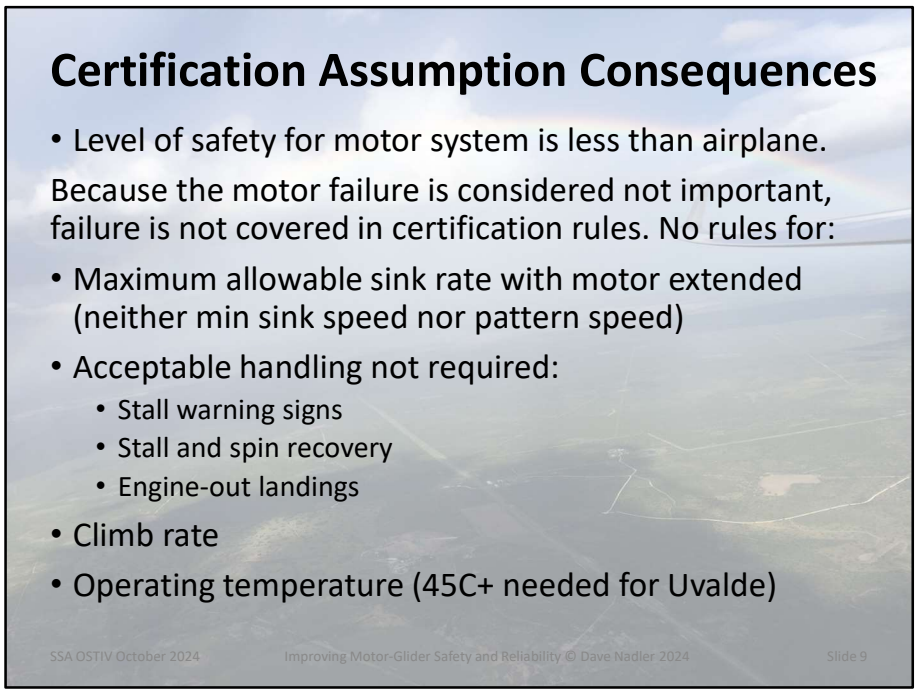
Please note vibration in left “before” portion of video, especially engine components and mast.
Right side is “after” - improved engine with balance shaft.

Vibration reduction achieved but with premature failures.
Updated design due for test run beginning 2025.



Moving on to certification issues (EASA)…

Just as we are expected to be trained for and recover from a launch cable break, we are expected to recover from any kind of motor failure at any time.



A sensible trade-off to require less safety than power plane;
otherwise we could not afford the motor.

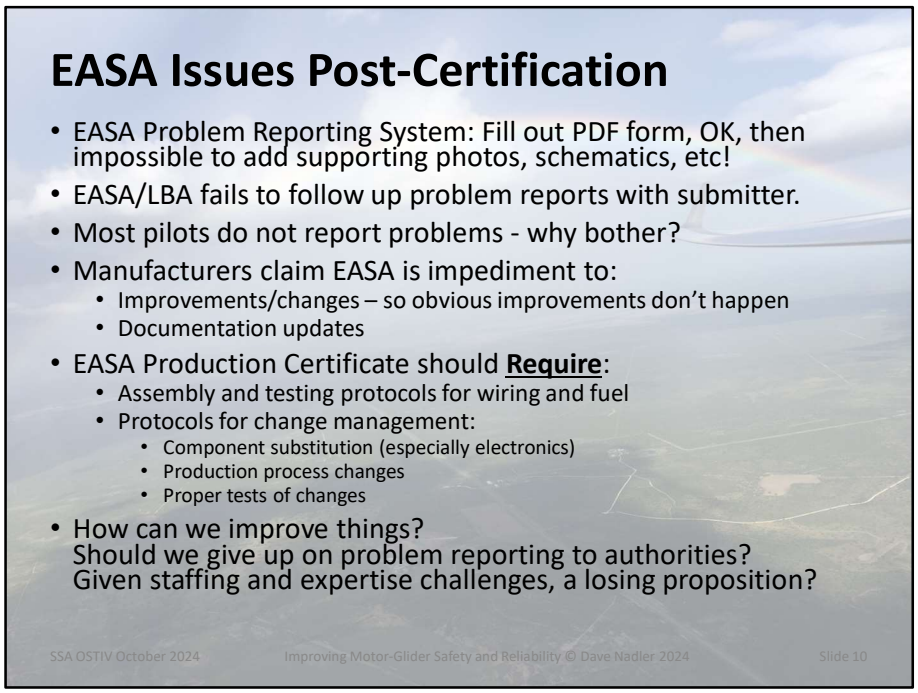
Stall warning is required; typically passive via clear buffeting
No stall warning is required for engine out condition.

You are a test pilot for stall and spin.

Some manuals prohibit engine-out landings, but for safety needs practice

Climb rate may be inadequate with sink or high density altitude

No required min and max temperatures for certification.
Temperature limits may be defined by manufacturer.



EASA has very limited staff working on gliding!

Once again:
- It is EASA policy not to provide feedback
- If no feedback is provided, perception is EASA does nothing.
- If EASA is perceived to do nothing, no-one will make submissions
- EASA is concerned it does not receive submissions
What is wrong with this picture?
Hello?

Also, manufacturers are required to report serious problems, but manufacturer decides if it is serious.

EASA/LBA folks at OSTIV meetings seemed surprised by problems I brought up…

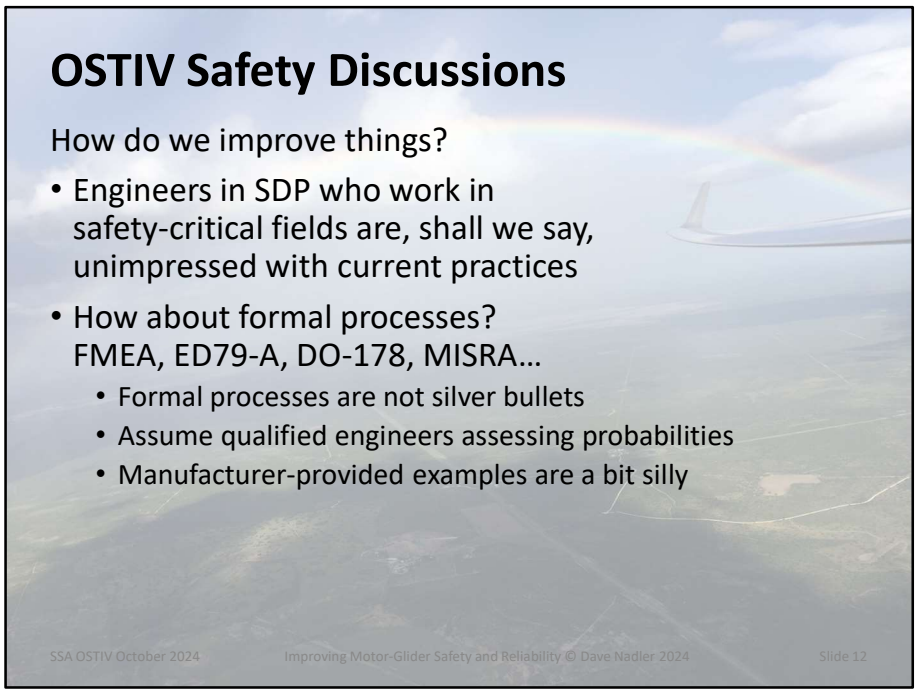
OSTIV, SDP, WEP

- The objectives of the OSTIV are to encourage and co-ordinate internationally the science and technology of soaring and the development and use of the sailplane in pure and applied research, the design, airworthiness and operation of gliders of all types, and the safety and training of pilots. Join! Technical Soaring!
- SDP is the Sailplane Development Panel, chaired by Michael Greiner. Participants include engineers from manufacturers, EASA regulators, and randoms.
- WEP is Working group on Electric Propulsion
- Dave participated in SDP/WEP meetings in 2021-2024

SDP discussions:
- work with EASA to improve certification regulations and processes.
- potential crash-worthiness improvements.
- cooling and temperature problems with electric motorgliders
- Is Nixus a glider?

Many mundane but important bits of regulations:
- Increase max weight to 850kg without special conditions
- Proper color coding of controls (red for emergency)
- Rules for electrical landing gear
- O2 system installation rule simplification/clarification for EDS
- Still correcting problems from translation and consolidation that created EASA regs.

WEP issues: Unstable criteria for battery approval (how to show compliance).
At 2022 meeting manufacturers agreed to jointly write a standard means of compliance for EASA,
but then failed to do so.
Regardless, battery pack approvals move forward at Solo, FES, Stephan Senger, etc.



ED79-A: European law requires functional safety analysis?

FMEA: Failure Mode and Effects Analysis

Notes on Current Situation…

- Light sailplanes are not included…
- Existing processes (development, certification) are tuned for doing what we've done in the past.
- Design/Update: Often missing 2nd set of eyes (review)
- These processes do not appropriately address complex systems (many interacting parts, modules, electronics):
  - System design (electronics, propulsion)
  - System integration (support for problem diagnosis)
  - Testing
  - Practical usage monitoring and support
- So, I've made some recommendations below…

Not many remaining manufacturers of ultralight sailplanes?
Alisport, Windward, GP – all defunct?
Who remains other than Albastar??

We are all tarred and feathered with mishaps of all manufacturers.

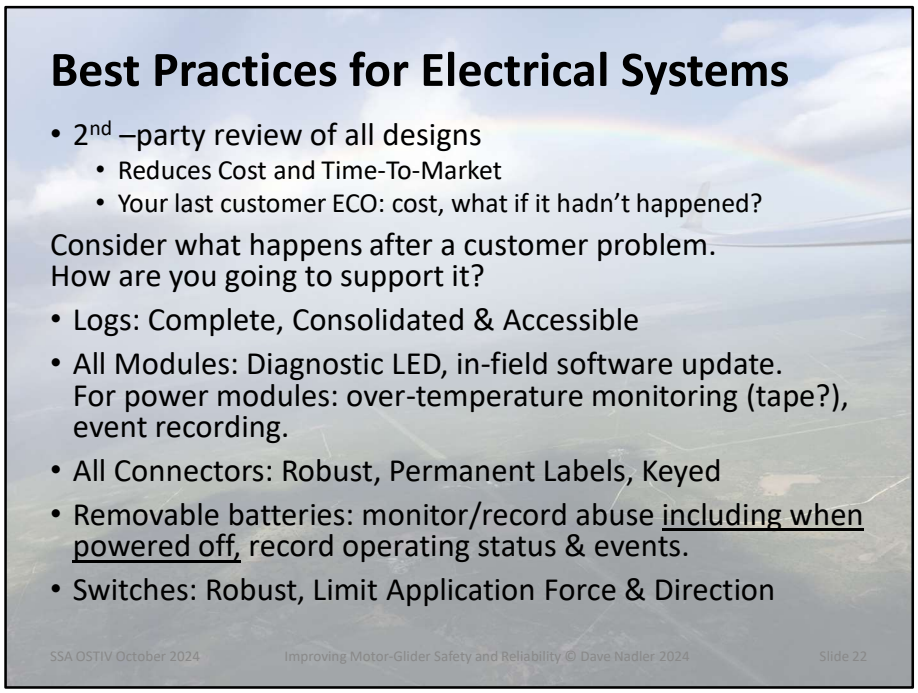
Attestation

- One way to avoid lots of rules: Require expert attestation to authorities, by manufacturer and designer and reviewer. For certification **and changes**!
- Suggested example attestation: **I attest that:**
  1. I attest I am expert in electronics with appropriate training and industrial expertise to design this (PCB, wiring system, battery system, etc.). I attest this unit complies with and has been tested to industrial norms.
  2. I attest I am expert in electronics with appropriate training and industrial expertise to review the above. I attest I have reviewed this unit's design, initial tests, production methods, and production tests, and I attest these comply with industrial norms.

What you really want is for each discipline, the best engineer you can find providing initial guidance and then review.
Typically the best expertise will be outside glider manufacturers.

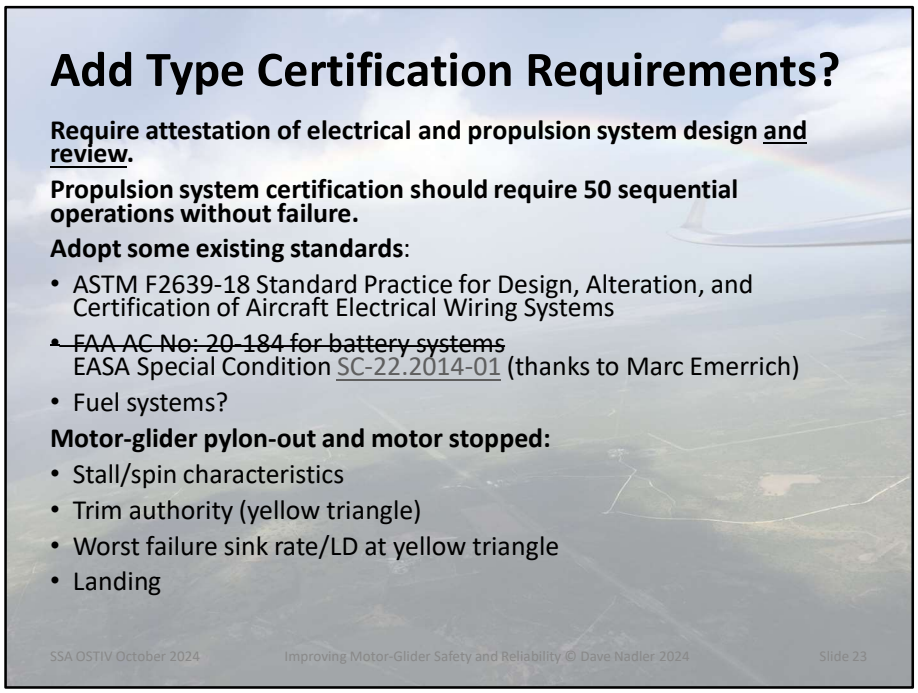
How much does Attestation Cost?

- If engineering is already done safely + cost-effectively?
  - A qualified engineer is doing design, and
  - A 2nd qualified engineer is checking.
  - So, no additional cost except minimal paperwork.
- If engineering is done with qualified engineer, but without review?
  - No extra cost for design, but
  - Cost of reviews will be less than savings from catching problems earlier. ***Reviews save money!***
- If engineering is done with unqualified staff? **This must stop**.



My opinion is that external review of early Lange work (engineering approach, electronic designs, testing approach) **could have saved at least one and maybe two years time-to-market**, by catching project and design issues before implementation and construction.

Consolidated (ie pilot inputs plus battery plus engine controller) recording of periodic status and all events is necessary for prompt diagnosis of problems. Creating this at start of engineering reduces cost and time-to-market. In the field issues need this for sensible problem diagnosis and resolution.



These are the simplest, most efficient things we can do to improve the situation.
Again, 2nd set of eyes tops the list for reducing trouble (and up-front costs).

Pick a number of cycles!
Many of the problems we've seen would have been surfaced by these requirement.

OSTIV – What To Do?

Motorglider reliability is **unacceptable**.
Let's not just be a talking shop.
How do we implement these ideas?
As a customer, you must insist on better…

Looking for suggestions…